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## Higher education in industrial engineering in Peru: towards a new model based on skills

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### Abstract

This article analyzes the progress of Industrial Engineering in Peru, the relationship to major trends in Europe and North America, and the projected outlook for the future. It is determined that the need for this engineering specialty includes a significant degree of resource management, and the formation of engineers through education requires not only the acquisition and strengthening of technical knowledge, but also the development of the competences that are required by both employers and the recipients of the benefits of engineering: society. Conclusions have been drawn based on state-of-the-art analyses from Europe and North America, and definitions of trends for engineering.

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### 1. History of engineering action in time

Present-day engineering is a profession in which the knowledge of basic science is applied to the efficient use of materials and forces of nature in order to meet the growing needs of humankind. Its development has been linked to the history of nations, as it reflects how humanity has adapted the world to meet its needs, as seen by the technical achievements that have been made.

Thus, it can be seen through the history of humankind that the initial discipline was a profession that strove to improve quality of life. The stages of human development can be marked by the findings of technical activities through history. One example is the Agricultural Revolution, which helped humanity to transform from a nomadic to sedentary lifestyle through the ingenuity to meet and fulfill basic needs by using craftwork, military activity, irrigation and construction. According to some historians, these changes arose in Syria and Iran starting in 8000 BCE. This shift in migration created new needs and demands. Consequently, the regions that were found along the overland route from China to enjoyed an advantageous position along with significant contributions of knowledge from emigrants, who simultaneously served as carriers of the knowledge they felt compelled to develop. These regions include the Middle East and the Mediterranean Sea, and stand out in history as cultures with the earliest development of engineering: Egyptian, Mesopotamian, Eastern Europe, Greek and Roman cultures. Within these cultures, scientific and technological advancements were promptly developed.

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The Roman Empire definitively fell in 476 AC. Within Europe contributions to engineering also declined between the years 600 and 1000 AC. Regardless, the precedent to modern technologies can be found in artisans, soldiers and medieval builders. War has always been an incentive for the development of human ingenuity, and as such, contributions from Asia arrived through invasions and the Silk Road.

During the High Middle Ages, between approximately 350 and 1050, each town formed its own culture but each one recognized the common core of the Christian-Roman legacy transmitted by the written Latin culture. This was a time of renewed artistic and intellectual vitality, wherein educational institutions flourished and interest in ancient culture was renewed. This need for intellectual advancement was preceded by various countries and regions in the form of advanced schools and later, universities.

## **2. Home of engineering in Europe and the U.S. (Garcia B, 2010)**

In the year 900 A.C. there were approximately 20 universities in Europe and in 1000 AC there were 200, an increase that can be credited to their mandatory creation in cities with cathedrals. In major European cities between the years 1088 and 1167, many universities emerged to study the seven liberal arts: arithmetic, astronomy, geometry, grammar, logic, music and rhetoric. The first were found: in Italy, Bologna and Salerno; in France, Paris, Chartres, Reims, Laon and Soissons; in England, Oxford in 1208 and Cambridge in 1209; in Spain, Salamanca in 1218.

In the late Middle Ages, about 1400 A.C a technological revolution emerged and spread throughout different disciplines, taking the forms of mining, post, cartography, census collection, and the transportation pathway development of highways, bridges, canals, locks and tunnels.

During the Renaissance, intellectual life surged throughout in Europe, including the schools of engineering and science. It began in Italy before 1400 and extended through the rest of Europe. Consumerism emerged in Europe with the exchange of luxury items. This trade promoted the improvement of navigation technology. Professor Lockard, of the University of Wisconsin, says: "Globalization first laid its roots between the eleventh and sixteenth centuries..." (Lockard, CA, 2010)

While the organized study of science and technology spread throughout the New World, the Industrial Revolution began in Great Britain, the beginning marked by the use of the steam engine for industry in 1780.

Until the late eighteenth century, the engineering profession as we know it today did not exist. The buildings were built intuitively on the basis of trial and error and according to the previous traditions of construction.

During the sixteenth and seventeenth centuries in Western Europe established true factories. The industrialization was led by the basic principle of the division of labor. In addition to mass production, industrialization also led to the specialization of labor and the increased interaction between science and industry. Likewise, it began the accelerated and indiscriminate use of natural resources and also the serious social problems that are derived from industrial machinery: the replacement of man by machine. This meant that man simply became a resource for production. Industry took space away from agriculture and technology displaced the use of the plow and oxen.

The Renaissance, the Enlightenment and the demands of the Industrial Revolution forced the creation of specialized centers for sciences and various branches of technology. The first engineering schools in France, initially military-based, argued that different jobs required different skills, which must be properly developed. In England, "The Industrial Revolution was made by hard heads and smart fingers." As a result, professional associations were created. One of which was the Institution of Civil Engineers (1818), who with the boom of the railroad specialized themselves as the Institution of Mechanical Engineers. It was during the second half of the nineteenth century that engineering arrived to the universities of Glasgow, Durham and London. In Germany in the late eighteenth century and early nineteenth century workshop culture and the cottage industry still prevailed. Although the Polytechnic University of France maintained a strong impact on the cultural environment of the region, it was not until 1809 that the "modern university" arose in Berlin, such being a center that combined teaching with research. By 1820 various polytechnic universities were set up in Berlin, Karlsruhe, etc. From these schools emerged electrical, mechanical, chemical, and civil engineers. Really, these graduates were middle-level technicians who had great influence on German industrial development. By the end of the century these schools had reached university status and

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